

LABORATORY/INDUSTRY NON-DESTRUCTIVE ASSAY PERFORMANCE DEMONSTRATION

TECHNOLOGY NEED

Transuranic (TRU) waste has been generated and stored since the 1940s. As a consequence of missions associated with nuclear weapons development and manufacture, related research and development, and operations associated with the production of plutonium, a sizable inventory of this waste has accumulated at numerous DOE sites. In recognition of the potential environmental, health, and safety problems posed by continued storage of TRU waste, such waste will be disposed at the Waste Isolation Pilot Plant (WIPP). In order for waste to be shipped to WIPP, the physical, chemical, and radiological properties of the waste must be characterized to ensure that the waste complies with the WIPP waste acceptance criteria. Most large DOE sites have constructed, developed, and calibrated waste characterization instrumentation to perform the required assays. The use of mobile characterization instrumentation is proposed for small sites where fixed-place capabilities are not cost-effective. Furthermore, mobile characterization is recommended for augmentation of characterization capacity at sites that have fixed-place capabilities.

The DOE intends to procure mobile characterization services from the private sector. Site operators are currently faced with the need to evaluate the assay capabilities of these private sector suppliers of mobile characterization services. The major operator concern is related to the quality and accuracy of the private sector capabilities. Because of safeguards issues associated with the control of plutonium, private vendors have not had plutonium sources to develop and test their instrumentation. Vendors have relied on relating assay system performance for californium or other radiological isotopes to the expected response for plutonium bearing materials. There can be significant errors associated with this approach. Further, these measurements have been made using artificial waste forms or surrogate materials that have limited physical and chemical similarity to actual waste forms. These facts make operator selection of commercial mobile characterization services risky in terms of cost, schedule, and potential for regulator findings of non-compliance with characterization requirements.

The instrumentation and software products currently offered by mobile characterization vendors represent the state-of-the-art for non-destructive assay technology. However, without evaluation using actual waste, technology problems or gaps may not be recognized or addressed. These problems or gaps could cause certain wastes to fail WIPP acceptance for disposal. Any waste that cannot be disposed at WIPP must be treated on site or maintained in storage. Either of these actions represents increased costs and risk.

The Idaho National Engineering and Environmental Laboratory (INEEL) currently stores and manages approximately two-thirds of all DOE contact-handled TRU waste. Since 1985, INEEL has been involved in development and application of non-destructive assay technology to characterize TRU waste. During these activities, the INEEL has gained extensive experience in non-destructive assay of waste, developed an understanding of the range of constituents found in the TRU waste, and fabricated surrogate waste materials that very accurately mimic the physical and chemical properties of actual TRU waste. Given the large inventory of TRU waste at the INEEL, all types of TRU wastes are readily available for testing of non-destructive assay systems. A large fraction of the inventory has undergone non-destructive assay by the fixed-place characterization capability and homogeneous wastes have been chemically analyzed. In this project, INEEL evaluates the non-destructive assay performance of some mobile characterization systems to identify potential technology gaps before they impact waste shipments.

TECHNOLOGY DESCRIPTION

Commercial and national laboratory-based mobile non-destructive assay systems were invited to participate in an INEEL-hosted performance evaluation that used both actual and surrogate TRU waste test samples. This performance evaluation/demonstration used samples that covered a range of waste

physical, chemical, and radiological attributes representative of approximately 90 to 95% of the DOE inventory of TRU waste in contact-handled 55-gallon drums. Replicate measurements were requested on each test drum to determine systematic errors and replicate precision. Following completion of the six-week evaluation, participant results for surrogate waste test samples were scored. The test results were scored with respect to non-destructive assay quality assurance objectives defined in the WIPP Quality Assurance Program Plan. The scores and actual values were provided to participants to aid in correction of analysis errors. The participants were allowed to submit revised results for the actual waste test drums based on surrogate waste corrections. Based on comparison of the assay results with previously determined characterization data, the performance of each mobile system was evaluated as a function of waste type. Following detailed discussions with the participants concerning the actual waste test results, assay instrumentation limitations, and analysis methodologies, the non-destructive assay technology limitations were defined. Based on the technical nature of the technology limitations, technology development opportunities were also identified.

BENEFITS

This performance evaluation provides for a side-by-side comparison of the performance of commercial and national laboratory-based mobile non-destructive assay systems as a function of waste type. Results of the evaluation indicate to site operators whether a certain mobile non-destructive assay system can satisfy WIPP performance requirements when assaying a particular waste type. This valuable data will support not only disposition of waste held at small quantity generator sites but at sites where mobile systems are being considered to augment fixed-place characterization capabilities. In addition, the technology gaps being identified can be addressed by technology development activities to obviate costly alternative waste disposition measures for waste types that cannot currently be certified for disposal at WIPP because of failure to meet characterization requirements.

CAPABILITIES/LIMITATIONS

The actual waste types being evaluated in this performance demonstration represent only waste produced by Rocky Flats production operations. The test samples represent general attributes of the waste form and may not account for unusual physical or chemical attributes of certain drums of waste. The performance results are representative of the mobile system configuration used in the evaluation. Different configurations, such as modified instrumentation or analysis methods occurring after this performance determination are not being evaluated.

COLLABORATION/TECHNOLOGY TRANSFER

This performance evaluation involved collaborative activities with one other national laboratory and two private companies. Private sector companies provided most of the funding for their participation in the evaluation. Improvements to analysis software that were made as a result of this evaluation enhanced the capabilities of the commercial mobile non-destructive assay systems that were tested.

ACCOMPLISHMENTS

This performance demonstration evaluated five mobile systems that used three different assay methodologies. Efforts are currently underway to work with participants to identify areas for assay methodology improvements and system upgrades. Two technical summary reports are being prepared. One report will assess the characterization performance as a function of waste type. The second will focus on identifying the technical limitation(s) of each mobile system and assay methodology and will highlight potential future technology development actions.

TECHNICAL TASK PLAN (TTP) INFORMATION

TTP No./Title: ID77C211 - DOE Laboratory/Industry Performance Demonstration Test

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The performance of Non-Destructive Assay and Non-Destructive Evaluation (NDA/NDE) technologies is tested on waste drums.